

## TITLE OF THE INVENTION

### **SIMULTANEOUS ACLR MEASUREMENT**

## BACKGROUND OF THE INVENTION

5           The present invention relates to radio frequency (RF) measurements, and more particularly to a dual channel measurement system for simultaneous adjacent channel leakage ratio (ACLR) measurement.

          Modern RF measurement equipment typically converts an input RF signal to an intermediate frequency (IF) signal which is then converted into a digital domain by an analog-digital converter (ADC). The intricate signal processing and measurement functions, such as applying a final measurement bandwidth to the signal, demodulation of the signal with subsequent modulation measurement if desired, or perhaps detection and logarithmic compression of the signal to obtain a spectral amplitude display, are then performed in a digital signal processing (DSP) system. The major difficulty of such an approach is with the ADCs. An ADC suitable for very wide dynamic range display of spectral components featuring a large number of output bits of precision may have a limited bandwidth, making demodulation of wideband signals impossible. An ADC suitable for measuring wideband signals featuring a very high conversion rate has a limited number of output bits, making wide dynamic range measurements impossible.

          The difficulty of the selection of ADCs is highlighted by the desire of those in the wireless communications industry to make what is known as a simultaneous ACLR measurement, which is the ratio of the power within a

transmitter's occupied channel to power leaked by the transmitter into an adjacent channel. When performing simultaneous ACLR measurements five or more wideband wireless signals are present. The term "simultaneous" means that measurements must be made simultaneously of each carrier's power and the resulting adjacent channel leakage signal. The reason for this requirement is that the instantaneous power of each channel varies somewhat, and it is desired to correlate the amplitude of the leakage signal with the variations in individual carrier power. This cannot be done if each signal is measured sequentially.

One approach to this measurement is to use a very high conversion rate ADC with as many bits of precision as possible. This limits the dynamic range of the ACLR measurement below what the wireless communications industry desires, so there is intense pressure to improve measurement performance. Another approach is to use three state of the art ADCs, each measuring a sub-band of the incoming signal. The results are "stitched" together using very complicated DSP techniques involving error correction in each channel, taking a fast Fourier transform (FFT) of each channel, stitching together the spectrum of the three FFTs, and then taking the inverse FFT of the result to achieve the time record of the wide measurement channel. This approach requires three very fast, state-of-the-art ADCs with a large number of bits and a large DSP processor to achieve the wideband result, but still does not achieve quite as much dynamic range as desired.

What is desired is a system for measuring simultaneous ACLR that is more accurate than present techniques.

## BRIEF SUMMARY OF THE INVENTION

Accordingly the present invention provides a system for simultaneous ACLR measurements that uses a dual channel measurement architecture. An input signal is down converted to produce a wideband signal that is input simultaneously to both a wideband channel having a high speed, low resolution ADC and a narrow band channel having a low speed, high resolution ADC. The resulting data streams from the ADCs are processed by a DSP to provide the simultaneous ACLR measurements.

The objects, advantages and other novel features are apparent from the following detailed description when read in conjunction with the appended claims and attached drawing.

## BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

Fig. 1 is a block diagram view of a dual channel measurement system for measuring simultaneous ACLR according to the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

The approach of the present invention allows the use of good, but not state-of-the-art, ADCs to achieve accurate simultaneous ACLR measurement results by dividing the measurement tasks. A wideband, lower dynamic range, channel is used to measure the amplitude of all five or more wideband wireless communications signals, which measurement needs only 40-50 dB of dynamic range since the sole required result is an accurate measurement of each signal's amplitude. A second, narrower, wide dynamic range

measurement channel is used to measure the leakage power in an adjacent channel. The two measurements are made simultaneously so that the instantaneous power of individual carriers is correlated with the leakage power. Two available ADCs are used to enable state-of-the-art dynamic range measurements.

Referring now to Fig. 1 a wideband wireless communications signal encompassing multiple wireless channels is input to a common down conversion channel **12** having a wideband output signal. The wideband output signal is input to two channels, a wideband channel **14** and a narrow band channel **16**. Each channel **14**, **16** has an intermediate frequency (IF) system **18**, **20** followed by an ADC **22**, **24**. The wideband channel **14** is normally centered at a higher frequency and features a much wider band IF filter **26**, such as 110 MHz, followed by a high conversion rate ADC **22**, such as 400 Msamples/sec, that has a relatively modest number of bits of precision, such as 8-10 bits. The narrow band channel **16** features a much narrower band IF filter **28**, such as 1-3 MHz, followed by a slower conversion rate ADC **24**, such as 25 Msamples/sec, with a much larger number of bits of precision, such as 14-16. The signal for the narrow band channel **16** may be derived via a switch **30** directly from the output of the down converter **12**, or might possibly be obtained from the output of the wide band IF filter **26** depending upon which is more advantageous. A local oscillator **32** for the narrow band IF system **20** is tunable to allow measuring a desired portion of the spectrum of the signal input to the narrow band channel **16**.

The used of frequency conversions in the two channels **14**, **16** is illustrative. It is quite possible that a very high speed ADC **22** in the wideband channel **14** may not require any frequency conversion between it and the down converter **12**. Further it is possible that to obtain sufficient spurious free  
5 tuning range, more than one frequency conversion stage **20** may be required in the narrow band channel **16**.

The outputs from the ADCs **22**, **24** are input to a DSP (not shown) to perform the necessary calculations for simultaneous ACLR measurements, as is known in the art.

10 Thus the present invention provides a system for simultaneous ACLR measurements of multiple wireless communications channels by using a dual channel system architecture that includes a wideband channel with a high speed, lower resolution ADC and a narrow band channel with lower speed, higher resolution channel, the outputs of the two channels being processed  
15 by a DSP to produce the simultaneous ACLR measurements.